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Australian Centre for International Agricultural Research

Annual report

project	Integrated pest management of stem borers and insect vectors of viral diseases of sugarcane in Indonesia.
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1 Progress summary

The project focuses on the following elements: i. identification of the most important pests and diseases of sugarcane in Java, ii. the development of improved IPM practices for these pests and diseases, iii. better extension of these practices to the sugarcane farming community, and iv. the development of additional resources to assist extension activities. The extensive general surveys conducted in 2008-2009, where over 930 individual sugarcane fields were surveyed (to determine both the incidence and severity of these pests in Java), has been followed by the selection of a much smaller number of specifically-affected crops for detailed monthly monitoring. This is enabling the ecology of the different pests to be studied in more detail to provide a better understanding of the most efficient management strategies that could be applied.

During the last 12 months, individual research experiments have also been conducted to further refine individual components of IPM strategies; these refined strategies will be integrated into the final project recommendations. A field experiment was established comparing application doses of the moth borer egg parasite Trichogramma; previously used release populations were compared with a higher release population. The results so far suggest previous recommendations were not optimal and will need to be changed. Sugarcane mosaic was found to be vectored in Java by the aphids Toxoptera citricida and Melanaphis sacchari. Molecular assay of commercial crop leaf samples has shown that over 80% leaves with mosaic symptoms are infected with sugarcane streak mosaic virus (SCSrMV); 3-5% are affected by sugarcane mosaic virus (SCMV). This is the first time the incidence of the different mosaic pathogens in Java has been quantified.

Training and project information meetings have been held in five factory areas, with total attendees being 185 people so far. Results from the project were outlined at each meeting and feedback gained from meeting participants. Participants related to project outcomes as well as information delivery in training workshops. Responses will be used to guide how future meetings are conducted as well as providing feedback for project planning purposes. Extension materials under development include a sugarcane pests and diseases field guide. Considerable progress was made during the last 12 months and a first draft is nearing completion. This publication will be in Indonesian, to be printed on water-proof paper, of pocket size and to become available in late 2010. Electronic materials from the guide will be used to develop other extension materials, including pamphlets, brochures and Powerpoint presentations..

An annual review meeting was held at Botu in eastern Java in April 2010. All project results were presented, results analysed and future directions decided. A report was written which also contains a summary of other travel by Australian scientists within the last 12 months. Travel was undertaken by entomologists, plant pathologists, the desktop publisher and extension staff.

2 Achievements against activities and outputs/milestones

Objective 1: To determine the distribution and incidence of stem borers, insect vectors and natural enemies in Java.

No.	Activity	Outputs/ Milestones	Completion date	Comments
1.1	Surveys	Identify the incidence of pests and diseases across Java	April 2009	Completed. Results reported previously
1.2	Sampling plan for detailed monitoring	Plan for monitoring	April 2009	Sampling plan decided and operational.
1.3	Ecological studies/ pest monitoring in a limited number of crops	Ongoing data (years 1-3 of project) on pest and disease incidence in monitored crops.	April 2011	A very large amount of data is being gathered at eight selected crops across Java. These were selected on the basis of previous data from the general survey; sites with high pest infestation levels were chosen. Monthly monitoring is quantifying the incidence of each moth borer species; this includes the percentage of stalks affected by each species, the type of injury caused by each species and the colonisation of the moth borers (eggs / larvae / pupae) by different parasitoids. Samples are being taken back to the facilities of the Indonesian Sugar Research Institute (ISRI) for detailed examination of the parasitoids (logging colonisation and species identities). Data is providing very good information on population changes during the growth of each crop, the crop damage caused by each species and what parasitoids are providing significant control of each moth borer species. The need to collect general information on the agronomy of each crop and management strategies applied by each farmer has been flagged,

Objective 2: To identify insect vectors and to assess transmissibility for mosaic-type viruses

No.	Activity	Outputs/ Milestones	Completion date	Comments
2.1	Collect potential vectors and test for transmission of sugarcane mosaic viruses	Identify mosaic vectors	April 2009	Vector transmission studies were completed and two aphid species were shown to transmit mosaic-type pathogens. A replicated experiment was conducted using healthy test plants with potential vector species first caged on mosaic-diseased plants. High levels of disease transmission were evident with the aphid species Toxoptera citricida and Melanaphis sacchari. Molecular assays are pending to show which mosaic pathogen was transmitted in these studies. Molecular assay of the crop samples collect on the general survey suggest that sugarcane streak mosaic virus is the more common pathogen (cf sugarcane mosaic). Research during the period also examined whether serial hot water treatments could eliminate the virus from infested planting material. Little success was achieved. Application of the technique on an industry-wide basis is unlikely and further research in this area has been shelved. Tissue culture as a means for eliminating the virus was also studied; it was found that 30% of tissue culture plantlets remained infested. This level of infestation suggests that tissue culture is not an ideal method for generating disease-free planting material - unless there was very limited material available for a valuable variety and there were no other disease-free sources of that variety.

Objective 3: To develop an integrated pest management (IPM0 program

No.	Activity	Outputs/ Milestones	Completion date	Comments

3.1	Role of natural enemies	Evaluate and measure the role of natural enemies	April 2010	An experiment was conducted where the previously recommended Trichogramma moth borer egg parasitoid (9,000 released in total between 0-4 months crop age) was compared to an increased parasitoid application dose (100,000 Trichogramma/week/ha for the first 4 months), a pesticide application plus a control 'no applied moth borer treatment'. The previously recommended application dose has been used in the Indonesian industry for over 30 years. Key outcomes from this work are: Borer pressure at 6 months crop growth is low-medium. The commonly-applied 'factory' treatment led to poor borer management – borer infestations were not reduced compared to the 'no applied treatment' control. There is the real possibility that the 'factory' treatments, utilised by industry for much of the 30 years since commercial treatments began, may have been largely ineffective. As regular monitoring of the effectiveness of these commercial parasitoid releases has not been undertaken, there are no data to substantiate whether applications have been effective. The chemical control treatment was the most effective in reducing '% bored stalks' and '% bored internodes'. This intensive chemical control program has been applied, in part, to enable yield potential to be measured in the absence of borers; this chemical treatment would not be practical or economic for routine commercial use. The recommended bioloogical control strategy is better than the 'factory' treatment Chilo species incidence and damage is more pronounced than Scirpophaga (top borer) at this stage)

3.2	Soft pesticides	Test the effect of soft pesticides	April 2011	Further consideration by the project team has led to consistent hesitation to explore this area. The reasons are - Disruption of parasitoid ecology: a strong concern was expressed that the application of pesticides would potentially disrupt the delicate ecology of the parasitoid populations. It was considered that it would be difficult to apply pesticides without reducing the effectiveness of natural and applied parasitoids. Indonesia culture: there was also a strong sentiment that the culture of the Indonesian industry does not include chemical applications and therefore research in this area would not lead to a readily adoptable outcome. Safety concerns: although soft chemicals are safer than a number of the potentially lethal insecticides previously used around the world, there are still remaining safety issues with chemical applications. Some of this is related to personal protective equipment, while other concerns are related to the type of equipment available for applying the insecticides. Practical considerations: Few countries use insecticides for borer control, and those that do (PNG, USA) apply insecticides from high-clearance tractors or aircraft. Only simple knapsack sprayers are available in Indonesia, and these are not an efficient method for treating large cane crops. Research on soft pesticides has therefore been delayed so that more effort could be directed to the work with parasitoids.

Objective 4: To transfer new technologies using appropriate extension methods to the farming, scientific, and quarantine community

No.	Activity	Outputs/ Milestones	Completion date	Comments
4.1	IPM training	Training workshops conducted .	April 2010	Five local training workshops have been conducted in different sugar factory regions across Java with over 180 farmers attending. Questionnaires completed by the farmers at the end of the training workshops provided valuable feedback on the relevance of project research, delivery of the training workshops and the research and extension areas where further information is needed. In general, feedback from the farming community has been very positive with the majority of participants suggesting the content of the workshops was appreciated, that the presentations were delivered well and that the project is addressing real needs and providing valuable information. Mr McGuire (Business and extension BSES staff member) attended some of these workshops to gain an initial understanding of the current approaches being used. Summaries of farmer feedback are presented in several figures (see Appendix A). In addition to local meetings around Java, a workshop for factory staff was conducted after the annual review meeting, in Pasuruan. Around 100 factory staff attended and the results were presented in Indonesian by project scientists; this included all the latest monitoring data for moth borers and the work undertaken with diseases. The meeting was again well received.
4.2	Industry leaders / champion farmers	Select champion farmers	June 2010	The parameters required for champion farmers were decided at the 2010 annual review meeting and arrangements made for their selection in the next few months. This will be undertaken by ISRI project staff in association with sugar factory personnel.
4.3	IPM training workshops	Train 200 farmers	April 2011	Training workshops are ongoing and over 180 farmers have received training so far (see 4.1)
4.4.	Demonstration plots	Select four demonstration plots	April 2011	The selection of demonstration plots was discussed at the 2010 annual review meeting and plans are in place to activate these according to project timelines.

4.5	Extension materials	Leaflets, Field Guide, manuals and videos	April 2011	Intensive development of the sugarcane pests and diseases Field Guide was undertaken during the last 12 months. A draft version nearing completion has been developed and it is hoped to refine this for printing in the latter half of 2010. A visit was made to Indonesia in late 2009 by the Australian project leader and the BSES desktop publisher; this significantly sped development of the guide, as did intense inputs by ISRI and BSES entomology staff. The guide will provide a valuable resource not only as a stand-alone publication, but also as a source of photos and text for use in other illustrations such as pamphlets and Powerpoint presentations.

3 Impacts

3.1 Scientific impacts

Scientific impacts at this point in time are limited. Research with application doses of the parasitoids is likely to be accessed and adopted by other scientists researching moth borers in other countries. However, because project research in this area has not yet been completed, these impacts are yet to be realised. Researchers in PNG and other parts of south east Asia are likely to consider carefully other results from moth borer research. Some discussion with PNG and Laos scientists related to moth borers has already occurred.

The common finding of sugarcane streak mosaic virus in Indonesian sugarcane fields is new and will cause Australian scientists to reconsider incursion management strategies for new forms of mosaic entering Australian. The proximity of sugarcane streak mosaic, and the high incidence of this particular virus in Indonesia, was not evident previously. The identification of two aphid vectors for the disease is also an important finding and their distribution in countries / regions bordering Australia, will also need to be taken into consideration.

The failure to eliminate mosaic-infested planting material with serial hot water treatment confirms other reports (though not all). This failure will be noted by other scientists working with sugarcane. The same applies to results with tissue culture elimination of the virus.

3.2 Capacity impacts

Training of Indonesian project staff has been ongoing during this project. CIRAD has provided a leading researcher in pest biological controls (Dr Regis Goebel) who has had experience with Trichogramma in a number of sugarcane producing countries around the world. In association with BSES entomologists, transfer of expertise to ISRI entomologists has been ongoing. ISRI scientists (Ari Kristini / Etik Acadian) will be visiting Australian sugarcane research and extension facilities within the next 4 weeks and further transfer of expertise / training will occur during this period.

Some improvements in glasshouse facilities at the Indonesian Sugar Research Institute have facilitated research with mosaic insect vectors and will facilitate on-going entomology activities. Repairs have also been made to the Indonesian Quarantine glasshouse facilities to facilitate sugarcane germplasm exchange. Extension equipment has also been purchased; this includes a data projector, screen and microphone so that training and extension meetings can be more effectively delivered in regional centres. A laptop computer was purchased so that legal desktop publishing software could be used by Indonesian project staff to translate the sugarcane pests and diseases field guide; electronic versions of the guide can now be emailed to Australia for guide collation.

3.3 Community impacts

Community impacts are not fully realised as yet because of the partial completion of project activities. This is especially so since project extension activities are most intense within the final 1-2 years of the project.

3.3.1 Economic impacts

Farmer training workshops are extending project results and these are making farmers aware of the issues associated with pest and disease control in the sugarcane industry.

As a result, farmers are modifying their management practices; this is just beginning and there are yet no quantitative data as yet. The refining of moth borer parasitoid recommendations will be very significant as results so far suggest that the routine releases of parasitoids made for over 30 years are not likely to have been effective. Sugar Factories are likely to be spending money on controls that are not working; application of effective control measures will not only eliminate a financially costly strategy, but will lead to a control measure that will lead to improved crop yields and greater financial returns. These changes are likely to occur in the next 2-5 years.

3.3.2 Social impacts

Social impacts are small at this stage in the project.

3.3.3 Environmental impacts

Environmental impacts are also small at this stage.

3.4 Communication and dissemination activities

There are several communication and dissemination activities that have been undertaken during the project period. Five farmer training workshops have been undertaken in regional sugar factory areas centring on the extension of better sugarcane pest and disease control strategies. Over 180 sugarcane farmers attended and very positive feedback was gained from these attendees. The latest project research results were extended, as well as best practice sugarcane cultivation techniques.

In addition, sugar factory staff were invited to attend an extension meeting at the facilities of the Indonesian Sugar Research Institute to hear of project related research outcomes. This follows the successful extension meeting held at the same location in 2009. These annual meetings were held immediately after the annual project review meetings attended by all project scientists. By doing this, all project staff have been able to attend both types of meetings, and where appropriate, to speak directly to sugar factory field staff. Around 100 people attended the 2010 meeting and again feedback was very positive. Some of those attending travelled long distances to be there (in cases up to 9 hours drive) and the general attitude of those attending has been very good with a keenness to learn evident.

Two papers on project activities were presented to the Australian Society of Sugar Cane Technologists conference, held in Bundaberg in May 2010. The papers were titled: i. IPM strategies for pest and disease control in Indonesia: project overview and outcomes from recent ACIAR-funded research, and ii. Monitoring of sugarcane moth borers in Indonesia; towards better preparedness for exotic incursions. Both papers were well received at the conference. In addition, a number of BSES Bulletin articles were published during the last 12 months on Australian biosecurity issues. Information and experience drawn from the ACIAR-funded project were used extensively in these articles.

4 Training activities

Five local training workshops have been conducted in different sugar factory regions across Java with over 180 farmers attending. Questionnaires completed by the farmers at the end of the training workshops provided valuable feedback on the relevance of project research, delivery of the training workshops and the research and extension areas where further information is needed. In general, feedback from the farming community has been very positive with the majority of participants suggesting the content of the workshops was appreciated, that the presentations were delivered well and that the project is addressing real needs and providing valuable information. Mr McGuire (Business and extension BSES staff member) attended some of these workshops to gain an initial understanding of the current approaches being used. Summaries of farmer feedback are presented in several figures (see Appendix).

In addition to local meetings around Java, a workshop for factory staff was conducted in in Pasuruan in April 2010 after the 2010 annual review meeting. Around 100 factory staff attended and the results were presented in Indonesian to these workers by project scientists; this included all the latest monitoring data on moth borers plus the work undertaken with diseases. The meeting was again well received.

5 Intellectual property

There are no intellectual property issues at this stage of the project

6 Variations to future activities

I raise two issues at this time, being: -

1. A current issue is the development of soft pesticides for control of moth borers. Considerable discussion at the annual review meeting was generated and led to the following summary -

There is consistent hesitation to explore this area. The reasons are -

Disruption of parasitoid ecology: a strong concern was expressed that the application of pesticides would potentially disrupt the delicate ecology of the parasitoid populations. It was considered that it would be difficult to apply pesticides without reducing the effectiveness of natural and applied parasitoids.

Indonesia culture: there was also a strong sentiment that the culture of the Indonesian industry does not include chemical applications and therefore research in this area would not lead to a readily adoptable outcome.

Safety concerns: although soft chemicals are safer than a number of the potentially lethal insecticides previously used around the world, there are still remaining safety issues with chemical applications. Some of this is related to personal protective equipment, while other concerns are related to the type of equipment available for applying the insecticides.

Practical considerations: Few countries use insecticides for borer control, and those that do (PNG, USA) apply insecticides from high-clearance tractors or aircraft. Only simple knapsack sprayers are available in Indonesia, and these are not an efficient method for treating large cane crops.

Research on soft pesticides was delayed so that more effort could be directed to the work with parasitoids. Further discussion on this is needed with the ACIAR project manager to determine the best way forward with this work.

2. A potential future issue is that the Indonesian project leader is expecting her first baby; whether this will affect her input into the project is yet to be determined.

There was a suggestion that this project may be extended for a further 12 months. Project staff have considered the areas of highest priority and are currently putting together a proposal for such as extension. Renewed contact with the ACIAR Research Manager will be made shortly.

7 Variations to personnel

I have just heard that the Indonesian Sugar Research Institute mapping officer, Pak Mulyadi, has just resigned and will no longer be involved in the project. I expect that ISRI will cover for this loss with other staff possessing relevant skills.

Dr Regis Goebel, CIRAD, France, has joined the project team. Regis has extensive experience with the biological control of stem borers in many sugarcane producing countries around the world. He brings very significant expertise to the project team. Dr Goebel is spending three years at BSES, based in Indooroopilly, Queensland; his time and much of his expenses are being funded by CIRAD. This provides a very significant opportunity for the project, in accessing his expertise in biological control of moth borers. He comes at virtually no cost to the project.

8 Budget